and Venus. Nothing else could be distinguished, not even the first-magnitude star Aldebaran. The plates exposed during the last half showed even less, as the clouds were then thicker.

The accompanying illustration (Fig. 2) shows the instrument used to obtain the photographs. If the weather had been fine it would have been possible to have obtained photographs which
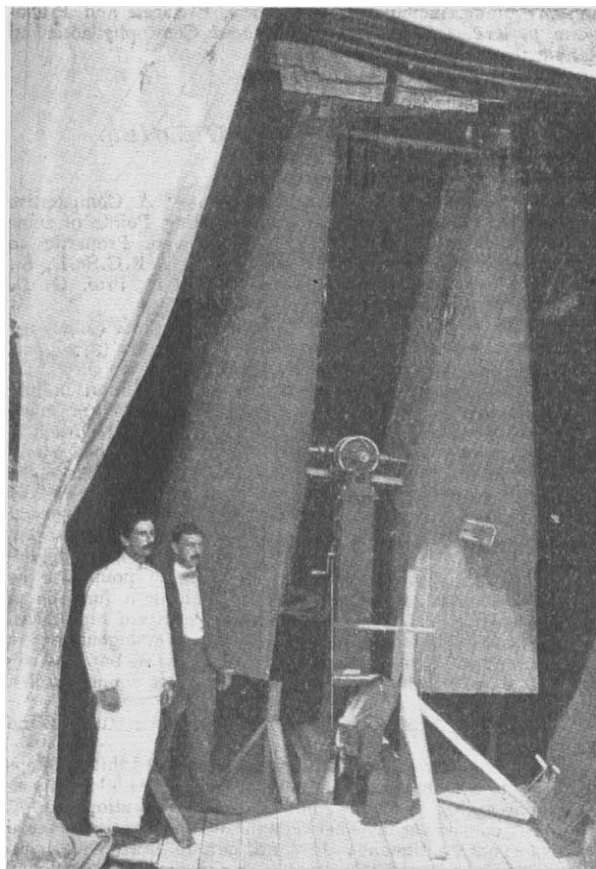

Fig. 2.—The Intra-Mercurial Planet Apparatus of the Smithsonian Institution.

would have decided whether the impressions of the supposed small planets within the orbit of Mercury, which appear upon the photographs of the previous eclipse, represent real bodies or not.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A FEW particulars of the late Mr. Robert Irvine's bequest for the chair of bacteriology in Edinburgh University are given in the *Lancet*. Certain shares in the Christmas Island Phosphate Co., Ltd., are to form a separate trust to be invested until the property accumulates to the value of 25,000*l*. or 30,000*l*., when the trustees are to pay the sum over to the Association for the better Endowment of the University of Edinburgh, or to such authorities in connection with the University of Edinburgh as the trustees shall deem expedient, for the purpose of founding a professorship of bacteriology in the University and the equipment of a class-room and laboratory for the teaching of the same, and for conducting original investigation in that subject.

FOLLOWING the example of the London Technical Education Board, the Central Welsh Board has arranged for a conference of science teachers, to be held on Thursday, May 15, at the County Buildings, Festiniog. At the morning meeting, papers will be read by Mr. J. Griffith, on "The Teaching of Science as a Preparation for Industrial Life," and Miss Holmer, on "The Value of Biological Teaching for Girls." At the afternoon meeting, papers will be read by Dr. J. J. Findlay, on "The Correlation of the Teaching of Science and Mathematics in Lower Forms," and Mr. W. Saunders, on "Nature Study as an Introduction to Science Teaching." It is hoped that the conference will assist the development of science teaching in Welsh intermediate and technical schools.

AT the Glasgow meeting of the British Association last year, a committee was appointed in connection with the section of Educational Science to consider the conditions of health essential to the carrying on of the work of instruction in schools. The committee is collecting information and tabulating records with reference to original observations on the periods of day appropriate for different studies, the length of lesson, and the periods of study suitable for children of different ages; anthropometrical and physiological observation forms in use in various schools, with a view to prepare a typical form for general use; anthropometrical and physiological observations recorded in different schools for a series of years on the same children; investigations into the causes of defective eyesight in school children and a definition of the conditions necessary for preserving the sight, and the practical knowledge of hygiene possessed by school teachers. Cooperation in obtaining information on these points is invited. Any facts or references relating to the subjects under consideration should be sent to the chairman, Prof. C. S. Sherrington, F.R.S., or to the secretary, Mr. E. White Wallis, 72 Margaret Street, W.

A NOTABLE event, marking the progress made by agricultural education in the States, will take place on July 7, when the first classes of the Graduate School of Agriculture assemble in the Townshend Hall of the Ohio State University. The Graduate School will provide advanced instruction in agricultural science for teachers and investigators. It meets under the auspices of the Ohio State University (where the movement originated), the Department of Agriculture, and the Association of American Agricultural Colleges and Experiment Stations. The session will last for four weeks, and parallel courses of instruction in animal husbandry, dairying, the culture of field crops and other subjects will be given by a special staff of thirty professors and lecturers, including many of the best-known teachers at the American agricultural colleges. The class-rooms, laboratories and apparatus of the Agricultural College of the Ohio State University will be placed at the disposal of this staff. Typical animals will be provided for demonstration purposes, and lectures will be illustrated by specially prepared specimens and diagrams. Admission to the school is limited to graduates, or to persons specially recommended by college authorities. The fee for instruction is six dollars, and the entire cost of the course, apart from travelling expenses, need not exceed thirty dollars.

SCIENTIFIC SERIALS.

American Journal of Science, April.—On the use of the stereographic projection for geographical maps and sailing charts, by S. L. Penfield. In continuation of previous papers on the same subject, the various modes of stereographic projection are described with photographic illustrations from models, with remarks on the use of the stereographic protractor for measuring distances along great circles, of measuring spherical angles at a given point, together with various applications in navigation.—On the hind limb of Protostega, by S. W. Williston. A description of a hind limb of what is probably *P. gigas*, found in the Kansas chalk two years ago. The specimen had for the most part been washed from its matrix, and the original relations of the bones lost. It is characterised by the femur being much more slender than the specimen described by Case.—The physical effects of contact metamorphism, by Joseph Barrel. Although much has been developed in past years concerning the physical, chemical and mineralogical effects of the metamorphism produced in sedimentary beds by the contact of igneous masses, but little has been said concerning the wholesale liberation of gases from the sediments so affected. The shrinkages of volume, the formation of vein fissures, impregnation deposits, and new intrusion

of igneous matter and other phenomena due to this cause are considered in the present paper.—An expedition to the Maldives, by A. Agassiz. The most important result of the expedition was the contribution to our knowledge of atoll formation. The present definition of atolls appears to be unjustifiable, as there is every possible gradation between a curved open crescent-shaped bank of greater or less size and an absolutely closed ring of land surrounding a lagoon without direct communication with the sea.—The flower-like distortion of the coronas due to graded cloudy condensation, by C. Barus. —Varying degrees of actinism of the X-rays, by J. O. Heinze, jun. It was found that the rays which are the most active in producing fluorescence are not those which act most vigorously in the photographic plate, and hence that the maximum effect on a platinocyanide screen does not coincide with the greatest photographic effect.

Bulletin of the American Mathematical Society, March. —The application of the fundamental laws of algebra to the multiplication of infinite series, by Prof. F. Cajori. Following up his previous work (see *Transactions* of the Society, vol. ii. pp. 25–36, and *Science*, vol. xiv., September 13, 1901) and also Pringsheim's (also in vol. ii. of the *Transactions*, pp. 404–412), Prof. Cajori here establishes a class of series with real terms which possesses the property of his former paper, but which seems to be distinct from the class given by Pringsheim. He then considers the validity of the fundamental laws in the multiplication of these infinite series, and next he points out another method for obtaining divergent series whose product is absolutely convergent. Lastly he generalises a theorem of Abel on the multiplication of series.—Dr. Fite gives a notelet concerning the class of a group of order p^m that contains an operator of order p^{m-2} or p^{m-3}, p being a prime.—Dr. Epsteen contributes a proof that the group of an irreducible linear differential equation is transitive.—Another short note follows by Dr. Eisenhart, on lines of length zero on surfaces.—Dr. Kasner, writing on some properties of potential surfaces, extends some of the results of a previous paper (*Bulletin*, vol. vii. pp. 392–9) to the surfaces expressed in rectangular coordinates by an equation $\phi(x, y, z) = 0$, where ϕ is a rational integral solution of the potential equation $\Delta\phi \equiv \frac{\delta^2\phi}{\delta x^2} + \frac{\delta^2\phi}{\delta y^2} + \frac{\delta^2\phi}{\delta z^2} = 0$. The last four notes were read before the Society and have numerous useful references.—Prof. Osgood gives an extended review of Prof. G. A. Gibson's "Elementary Treatise on the Calculus," in which he remarks that though many teachers may not see their way to use it as a text-book during the early part of the course, yet the book can be commended for collateral reading from the very beginning, and that teachers will have to consider whether it may not be taken as the chief text-book in the second course.— Further short notices follow of Cahen's "Éléments de la Théorie des Nombres" and of R. Dedekind's "Essays on the Theory of Numbers" (Beman's translation) by Prof. L. E. Dickson, and of the "Annuaire pour l'An 1902" by Prof. E. W. Brown.

Memoirs of the St. Petersburg Society of Naturalists, Botany, vol. xxx.—On parasite fungi found in the neighbourhoods of St. Petersburg, by K. S. Ivanoff. List of 153 species, with a few remarks.—Critical review of the flora of Moscow, by A. N. Petunnikoff. Second part, continued from *Botanicheskiya Zapiski*, part xiii., 1896 ; full summary in German.—Botanical researches in the province of Orel, by M. D. Zalessky ; summary in German. A portion of this paper is given to a detailed description of a Scotch-fir forest on a Loess soil, which is a rare case in Russia, and which the author explains in accordance with the views of Litwinow (*Bull. Soc. Nat. Moscou*, 1890, No. 3) on the survival of fir forests during the great Pleistocene glaciation.—On dormant buds, by W. Lubimenko, with twenty-nine figures ; summary in German.—Exploration of the flora of Pskov in 1899–1900, by N. Puring.—The flora of the Polyesie, by Joseph Paczosski, continued. The Monocotyledones, Nos. 951 to 1291, are now given, and this most valuable work is thus concluded.

Vol. xxxi.—The whole of this volume is given to the first and the second fascicules of "Flora Caucasica Critica," by N. Kuznetsoff, N. Busch and A. Fomin. The intention of the authors is to give, in a series of monographs disposed in the same system as in A. Engler's "Pflanzenfamilien," the necessary materials for an abridged "Flora of the Caucasus." This latter would be

for general use, while the present work must be a sort of preparatory work for specialists only. The successful accomplishment of this grand undertaking seems to be guaranteed— the editor, Prof. Kuznetsoff, having reasons to believe that the work will find the support of specialists. We may remark that under the heading of habitus we find for certain species extremely valuable and most interesting descriptions, which will be welcome to both the systematist and the geographer. The present volume includes the Pirolaceæ, Ericaceæ and Primulaceæ, by Kuznetsoff, and the Nymphaceæ, Ceratophyllaceæ and Ranunculaceæ, by Busch.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, November 28, 1901.—"A Comparative Study of the Spectra, Densities and Melting Points of some Groups of Elements, and of the Relation of Properties to Atomic Mass." By Hugh Ramage, B.A., A.R.C.Sc.I., St. John's College, Cambridge. Communicated by Prof. G. D. Liveing, F.R.S.

The properties of nineteen elements were studied, namely :— (1) Lithium, sodium, potassium, rubidium, cæsium ; (2) copper, silver, gold ; (3) magnesium, zinc, cadmium, mercury ; (4) calcium, strontium, barium ; (5) aluminium, gallium, indium and thallium. The flame spectra of the metals are much simpler than the arc or spark spectra ; they may be regarded as the fundamental spectra of the metals. They furnish purely experimental data with which to begin an investigation of the laws which govern the distribution of lines in spectra and by which to study the relations of the physical and chemical properties of the metals to their spectra. Diagrams were drawn with the oscillation frequencies of the lines in the fundamental spectra, or the densities, or the melting points, of the metals as abscissæ, and the atomic masses, or a function of these, as ordinates. Two diagrams of spectra are reproduced in the paper. The corresponding lines in homologous spectra were joined by lines some of which are straight, but most are curved. The densities and melting points were connected in a similar way.

The following facts have been observed in the study of the diagrams :—

(1) The metals considered may be classified into groups according to the characters of their spectra. The elements in each group appear to have a similar atomic constitution.

(2) The connecting lines between the members of the chemical groups are not continuous ; there are certain breaks in them. These occur between the metals sodium, magnesium and aluminium, and the metals of their respective groups with higher atomic masses. The break between the sharp series in the spectra of the aluminium group is very slight ; that between the diffuse series is very marked and corresponds to marked changes in the densities and melting points of these elements.

(3) The cause of the displacement of corresponding lines in some strictly homologous spectra is intimately connected with the atomic masses. The shift of the subordinate series of potassium, rubidium and cæsium is approximately proportional to the atomic mass, whilst the shift of the principal series is very nearly proportional to the square of the atomic mass.

(4) The second diagram, drawn from the spectra and the squares of the atomic masses, shows that the lines which connect the corresponding members of homologous doublets and triplets approach one another as the atomic mass decreases and intersect on the line of zero atomic mass.

The spectra of potassium, rubidium and cæsium change regularly with the atomic mass, and it should be possible to express the series in these spectra by a formula in which the atomic mass is the only variable. There are obvious difficulties in modifying Kayser and Runge's formula in this way, but Rydberg's formula is more general and the constants are more easily calculated. Rydberg's formula and method give better results for the subordinate series than for the principal series ; also for the series in the spectra of elements of low atomic mass than for those of high. The best results were obtained for the principal series of the three metals when in Rydberg's general formula

$$n = n_\infty - \frac{N_0}{(m + \mu)^2}$$